



ONK Spring 2017

## OCP TIP 중심의 오픈소스 5G/IoT 이동통신 구현 기술

2017. 4

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하늘 아래 새것은 없으니

과거를 회상해 봅니다

# 과거에 대한 회상

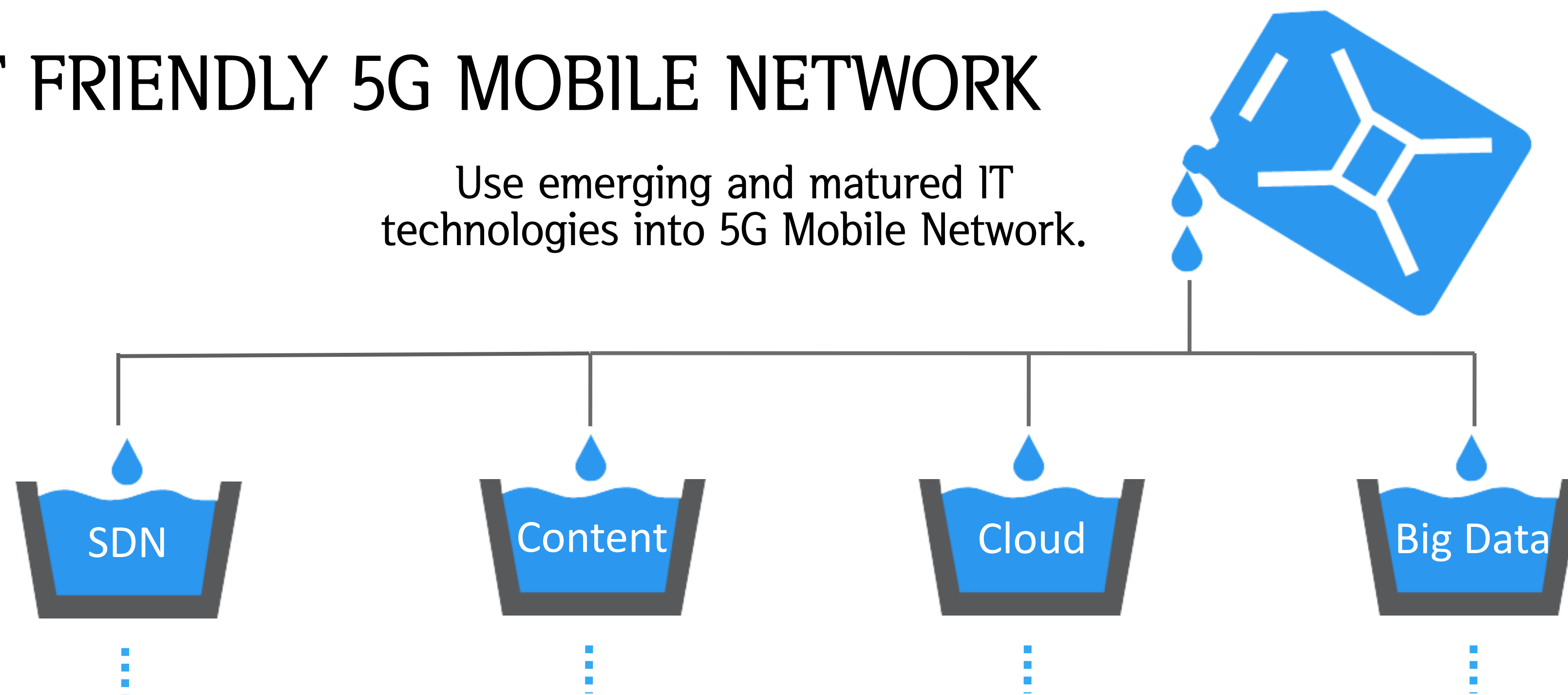
“2013년 7월 - 5G 네트워킹 발전 방향”

## 5G Network Design Philosophy

“Telco의 기술에 집착하지 말고, IT의 기술을 효율적으로 흡수하는 吸星大法”

### IT FRIENDLY 5G MOBILE NETWORK

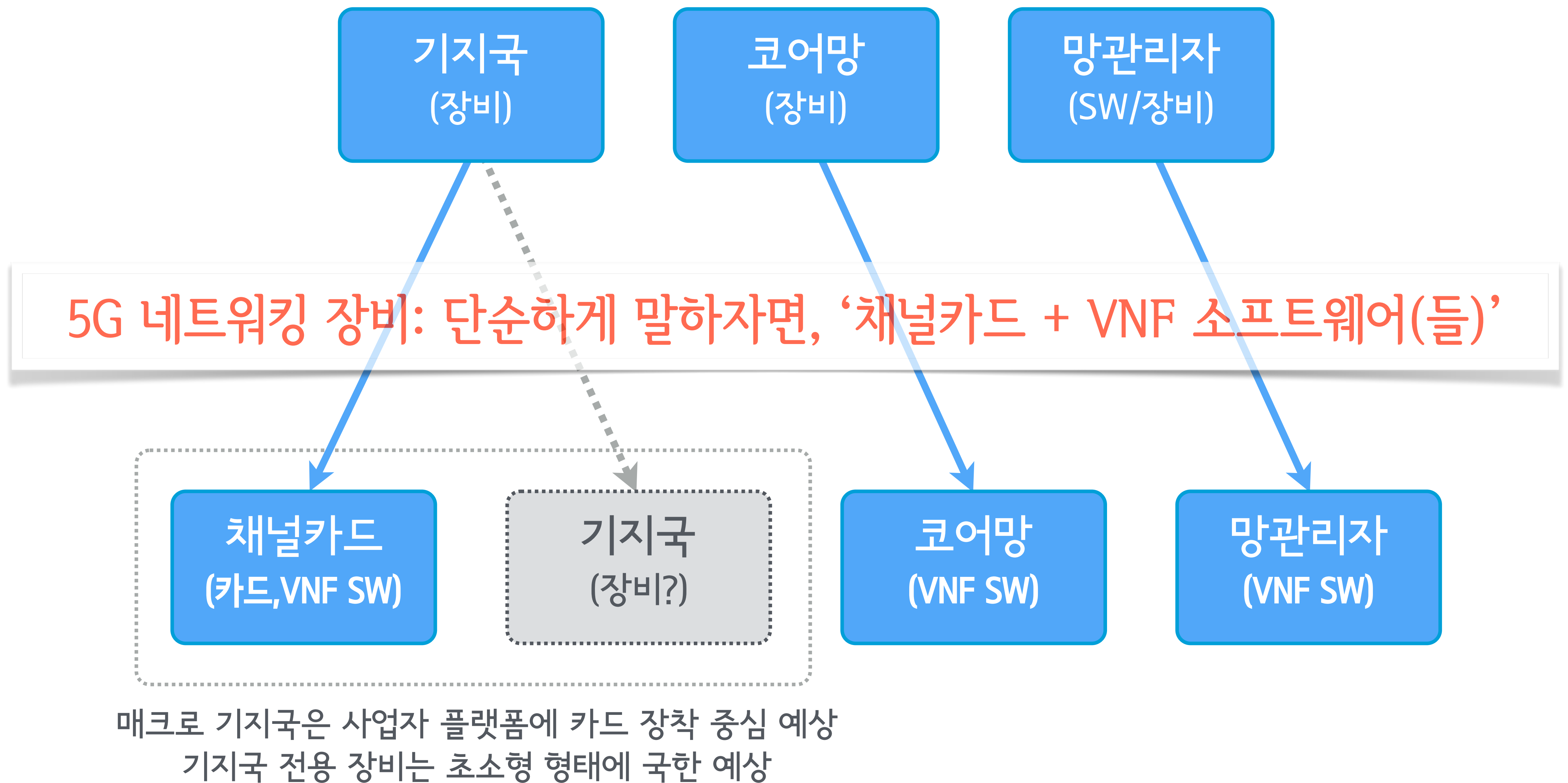
Use emerging and matured IT technologies into 5G Mobile Network.



## Service & Network Integrated 5G

# 과거에 대한 회상

“2015년 2월 - SDN/NFV와 오픈소스에 따른 5G 네트워킹 장비 방향”



# 과거에 대한 회상

“2015년 2월 - SDN/NFV와 오픈소스에 따른 표준 & 설계 철학 변화”

## PAST

NE Oriented  
(eNB, SGW, PGW, MME)

Standard (Only)

Uncontrollable Network  
(IP Networking)

## 5G

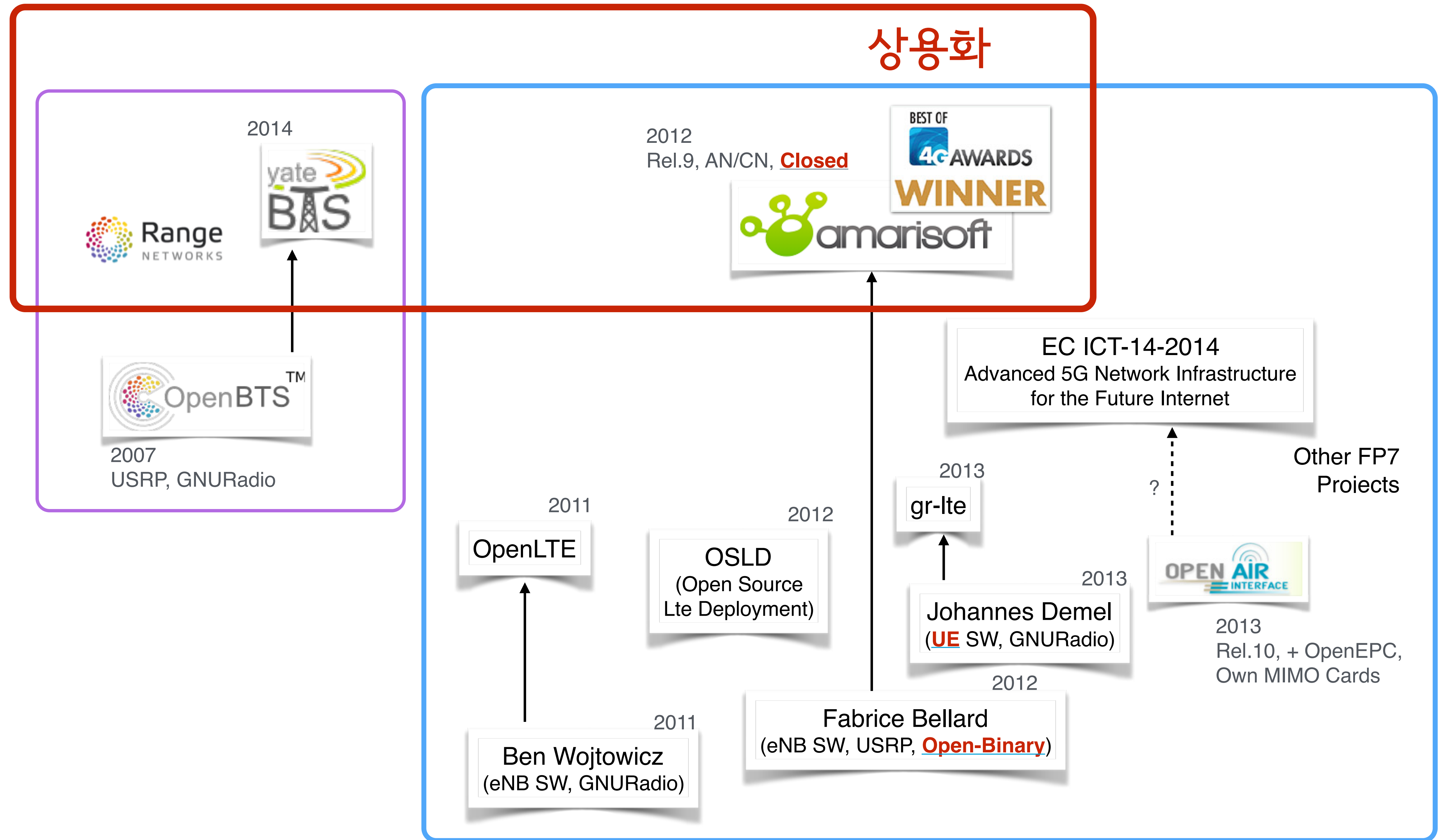
Function Oriented  
(eNB & VNFs)

Software APIs (Major)

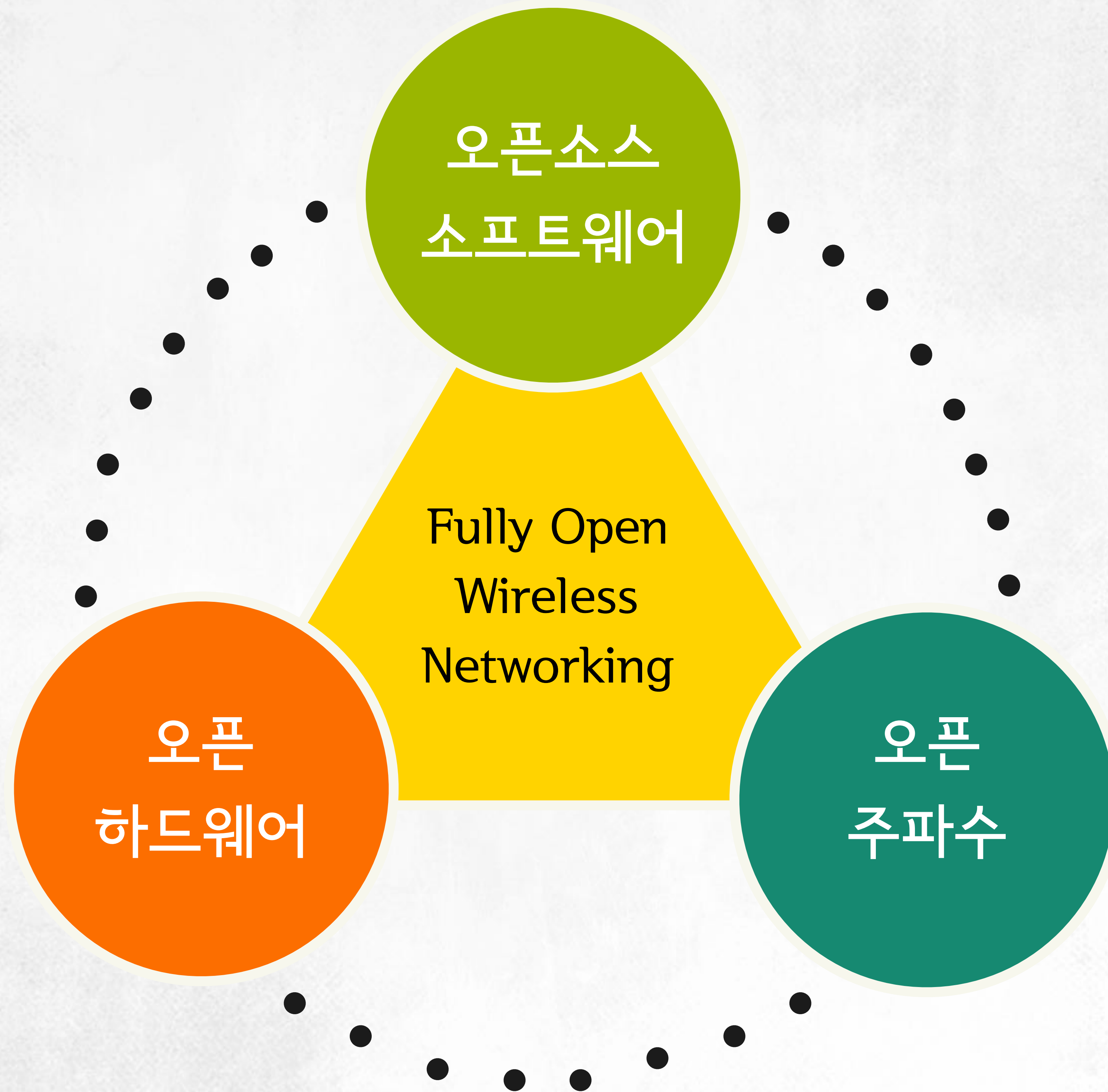
Controllable Network  
(SDN/NFV)

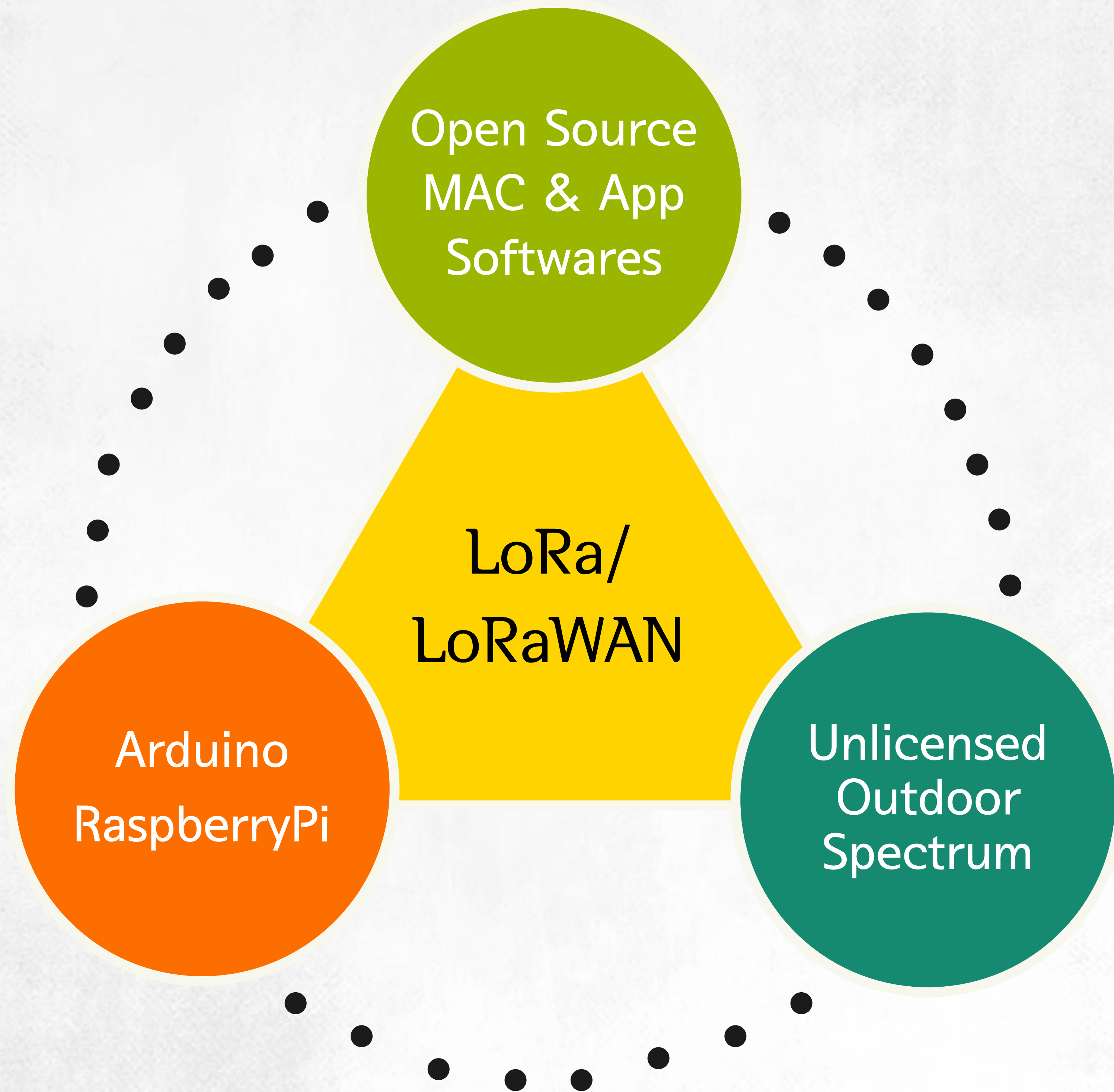
# 과거에 대한 회상

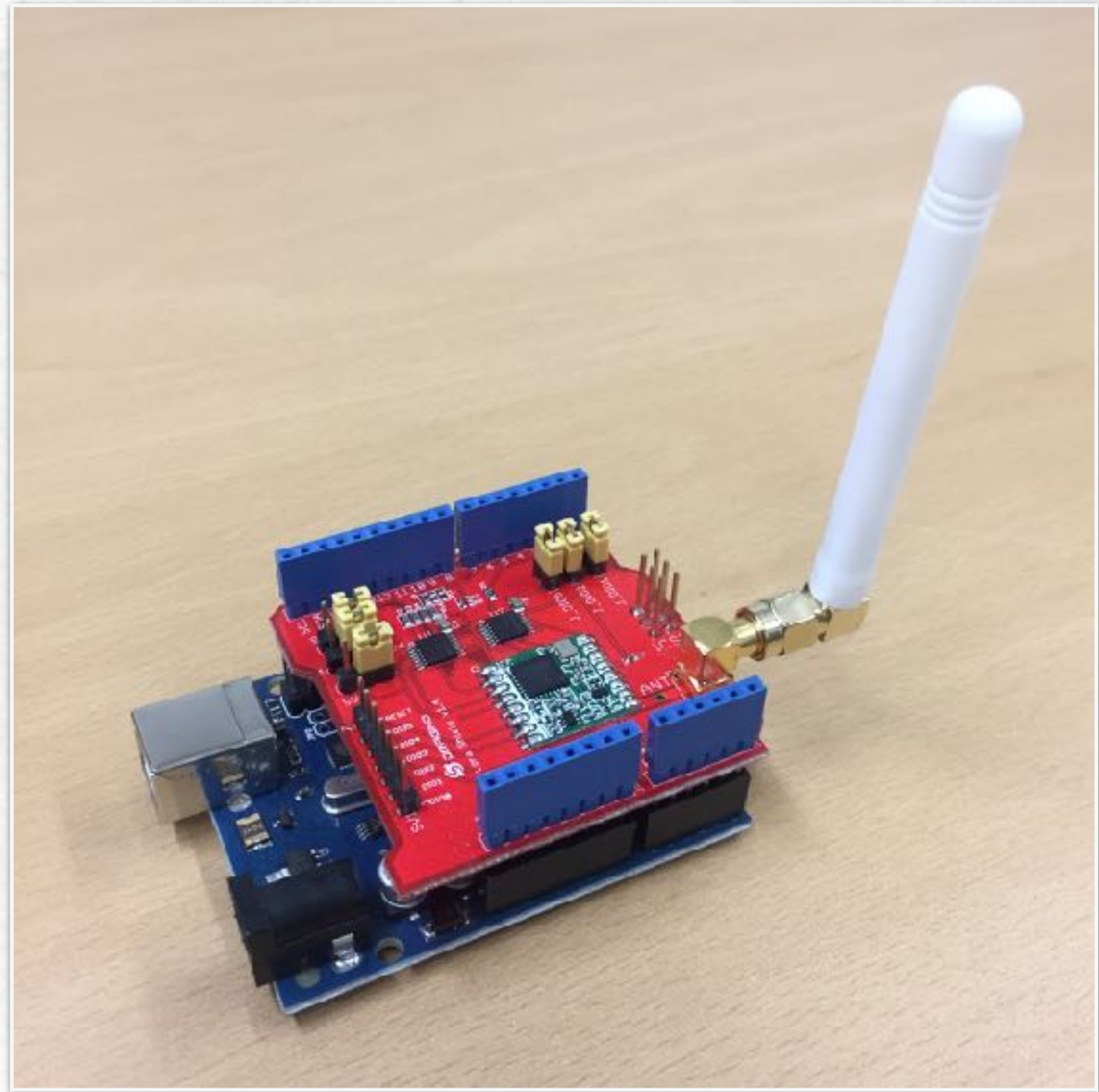
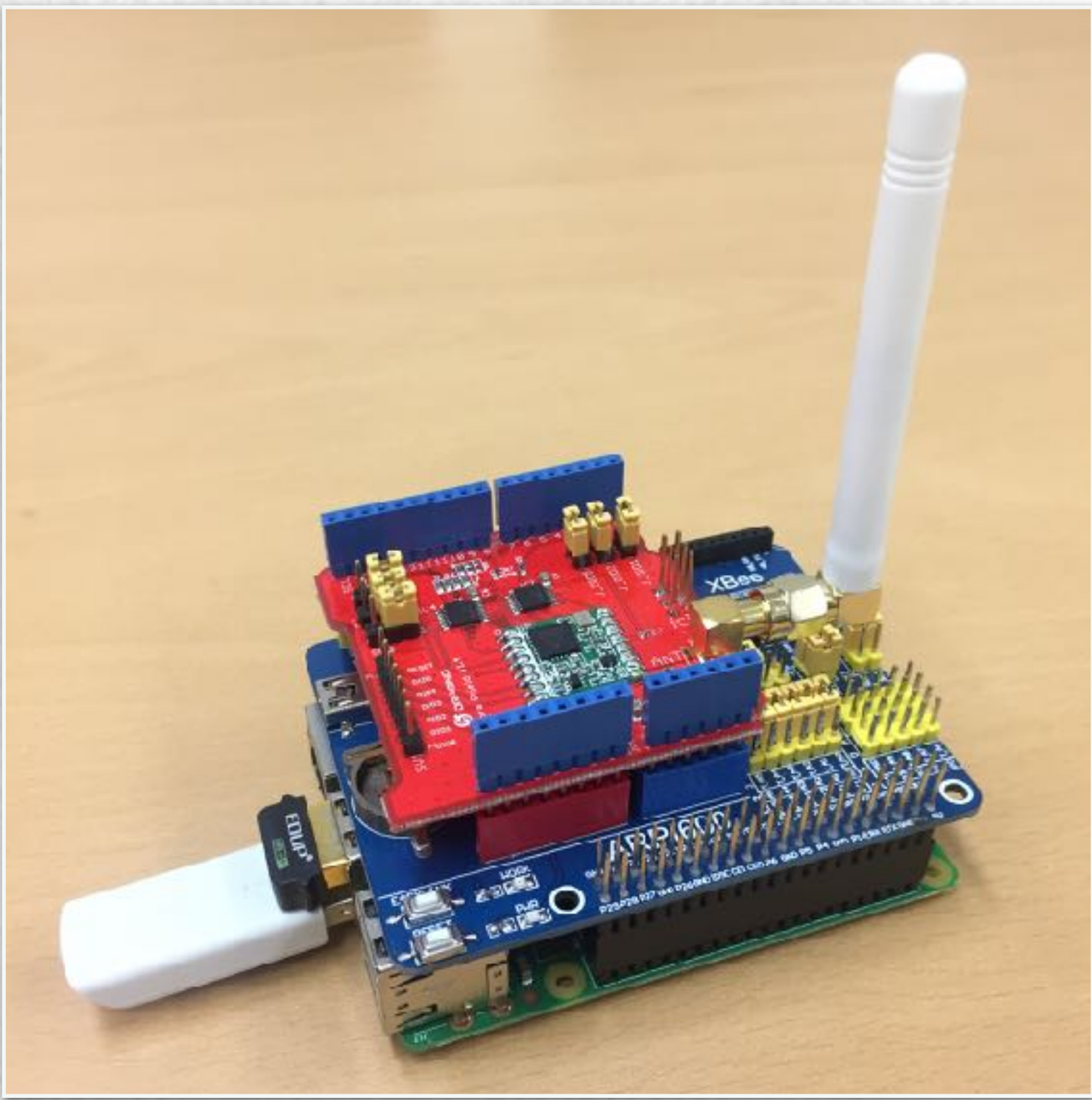
“이동통신 네트워킹의 오픈소스 소프트웨어화 History”



# OPEN@Today





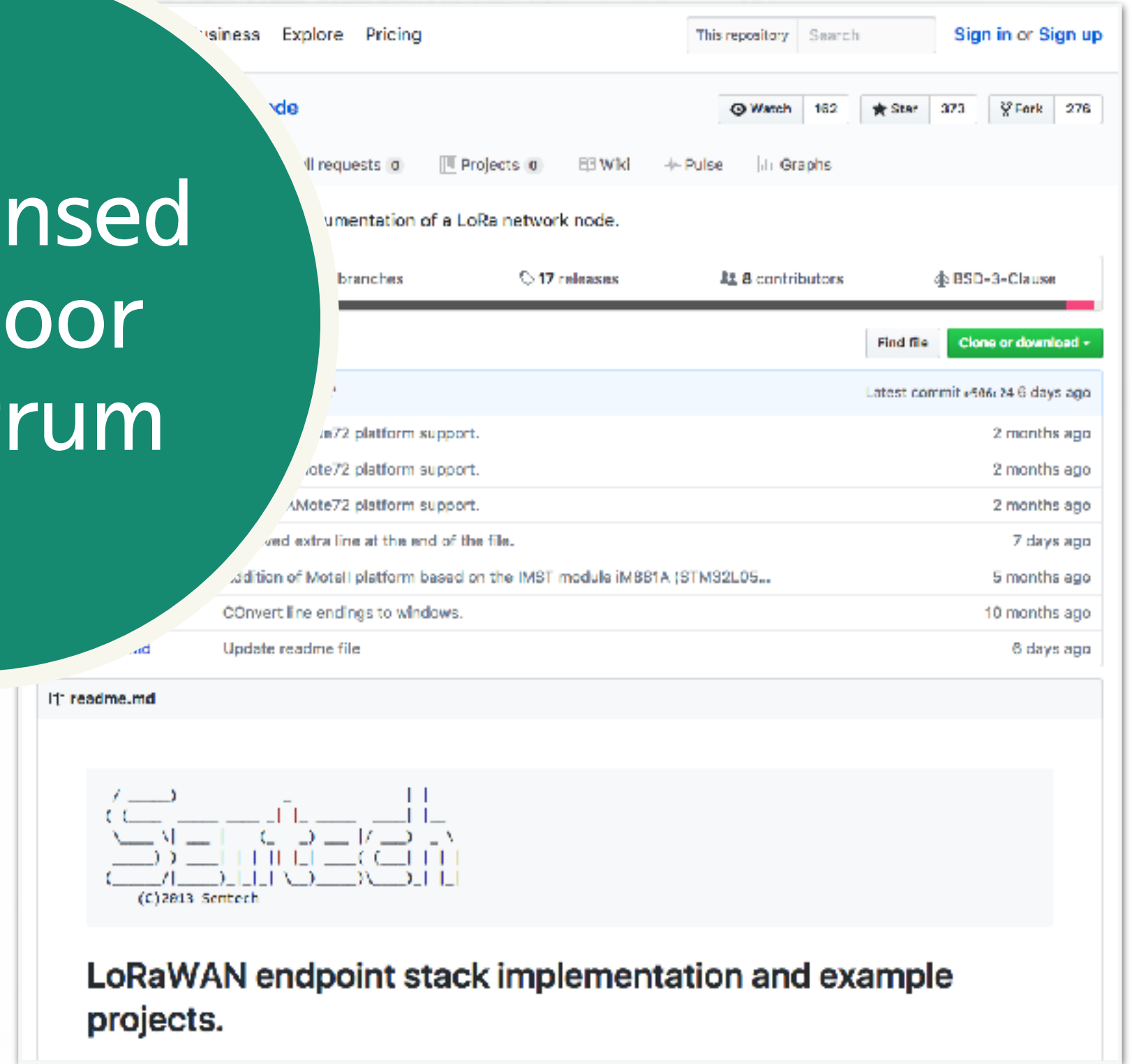


Open Source  
MAC & App  
Softwares

LoRa/  
LoRaWAN

Arduino  
RaspberryPi

Unlicensed  
Outdoor  
Spectrum



# OCP

# OCP Roadmap



# One Year Experience

## OCP Networking as of March 2015

Network disaggregation is here!



- One accepted switch
- Software building blocks
- Testing efforts starting

**Takeaway:**  
Disaggregation was here,  
but still ramping up!

## OCP networking hardware



## 11 OCP data center switches accepted

**Edge-core®**

▪ 16x40G

## Newly shared OCP specs - new DC switches

**ALPHA**

## Newly shared OCP specs - new silicon

**Edge-core®**

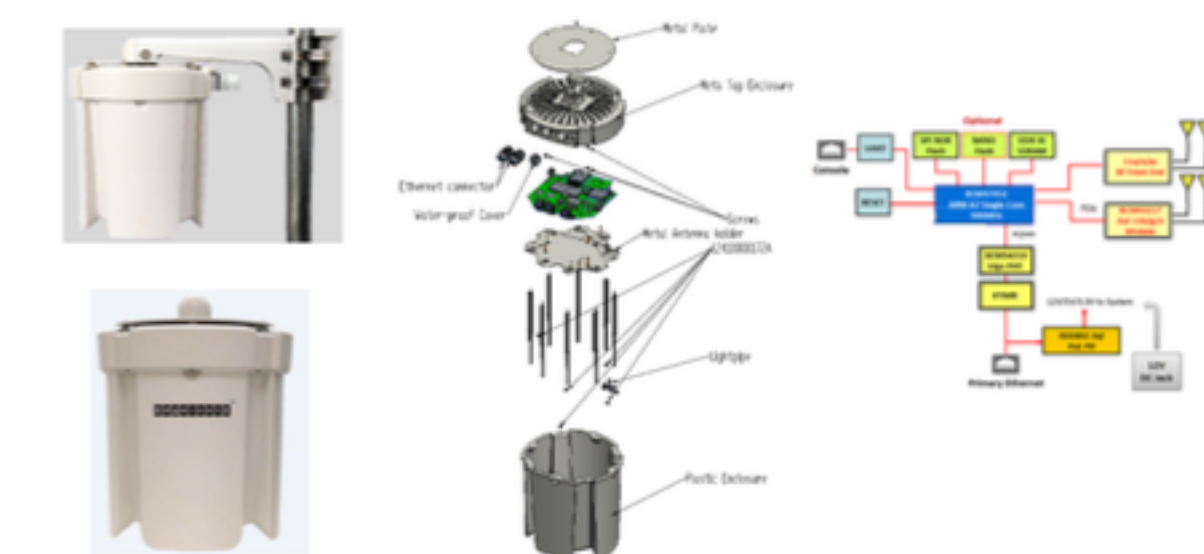
## Newly shared OCP specs - chassis/modular

**Edge-core®**

## Newly shared OCP devices - edge & access

## Newly shared OCP devices - access points

**Edge-core®**  
NETWORKS



- 2 indoor, 1 outdoor
- 802.11ac

# One Year Experience

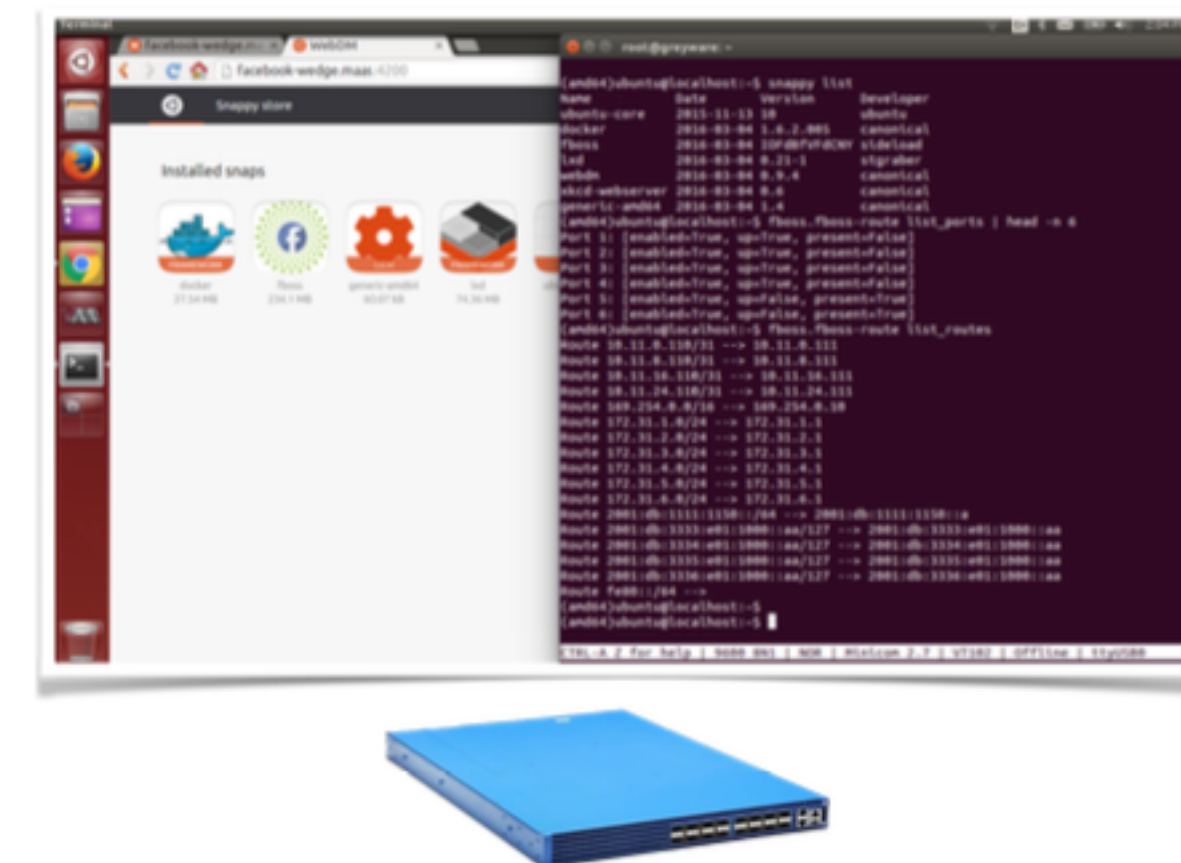
## A growing ecosystem of software



- Multiple projects and providers emerging
- Open source and commercial
- Distributed and centralized

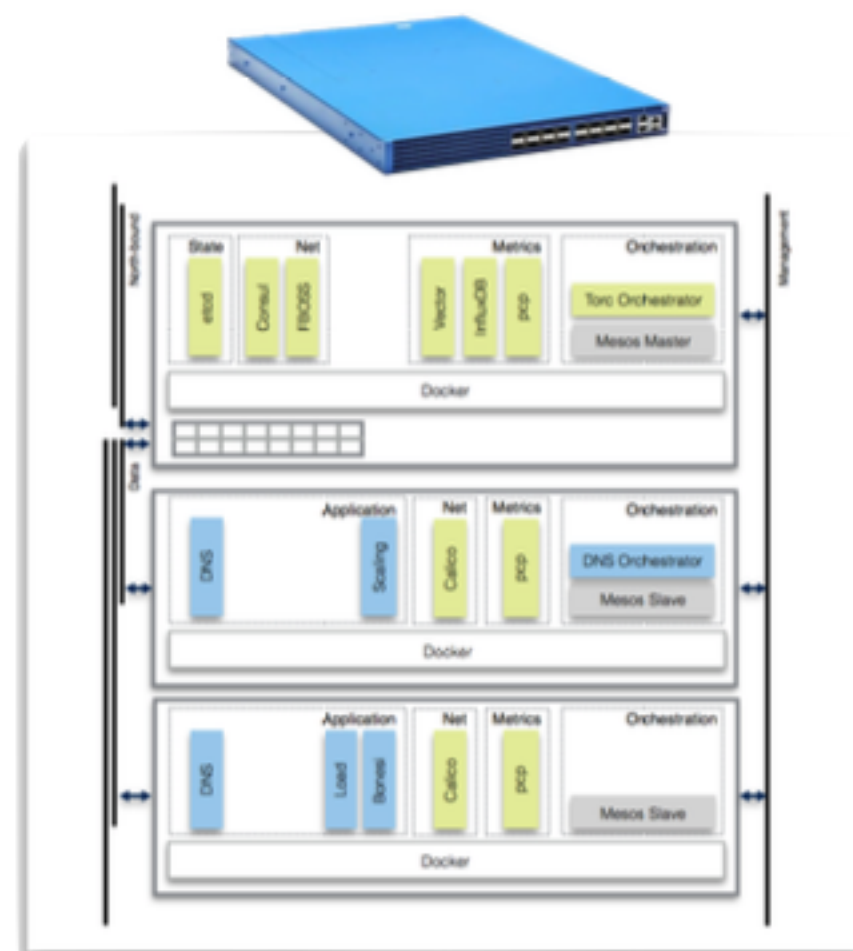
## OCP Wedge Demos:

CANONICAL



- Managing Wedge via "Metal-as-a-Service"
- Created an FBOSS snap
- OCP Hack-a-thon - created an Open Switch snap

## OCP Wedge Demos:



- TORC - "Applications, Microservices, VNFs controlled by Top-of-Rack Controller"
- Used Wedge's micro-server extensively
- Docker, Mesos Master, FBOSS, OpenNSL, ONL, OpenBMC, Calico

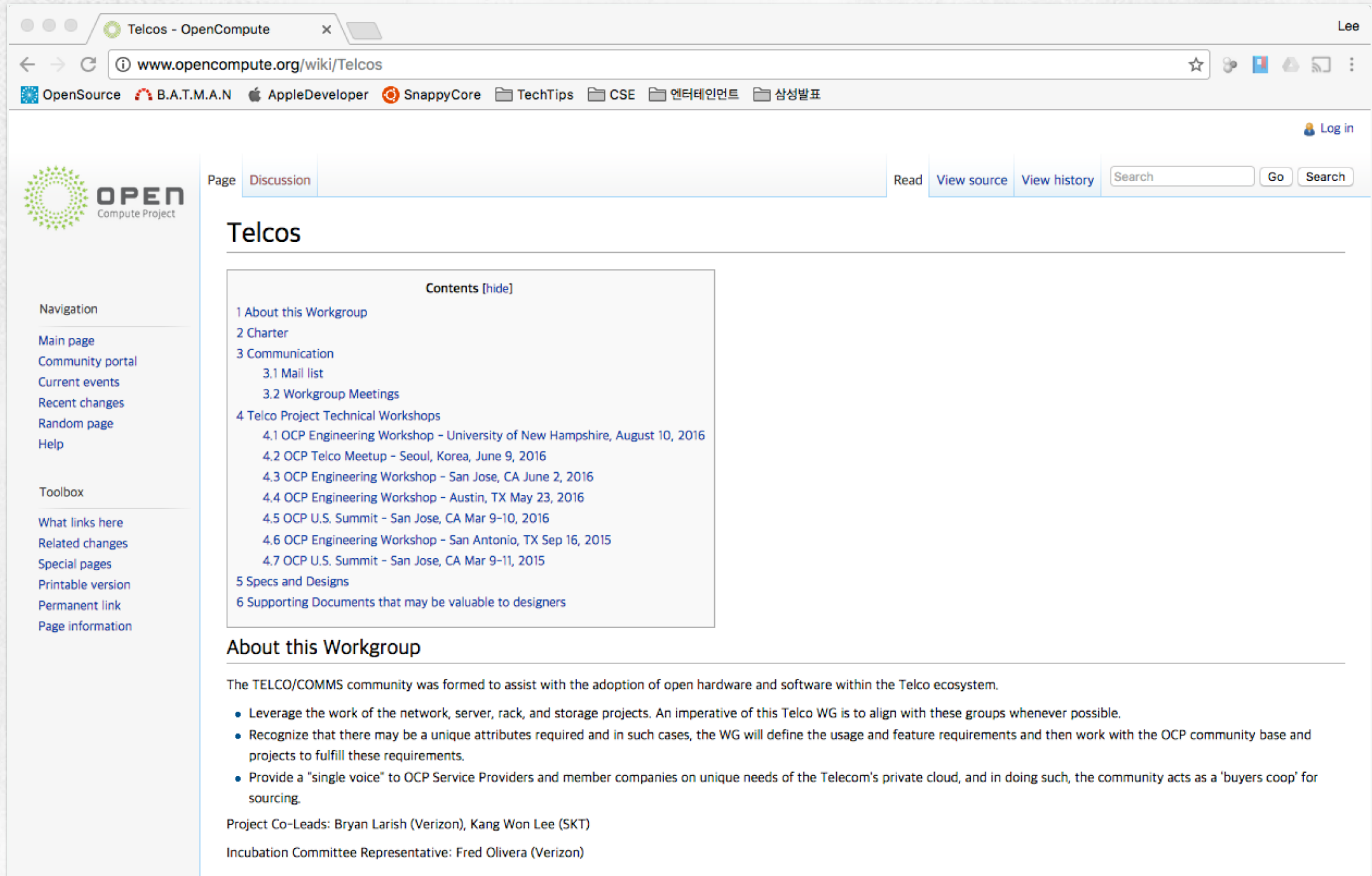
## OCP Wedge Demos:



- "Evolving a Telcom operator network into an IT convergence network"
- Ported OpenSwitch to Wedge
- Ported Indigo to Wedge
- OpenFlow support
- Interested in SAI

# OCP Telcos

## “Facebook에 의한 OCP Movement”



The screenshot shows a web browser window with the URL [www.opencompute.org/wiki/Telcos](http://www.opencompute.org/wiki/Telcos). The page is titled "Telcos" and is part of the "OPEN Compute Project" wiki. The left sidebar contains navigation links such as "Main page", "Community portal", "Current events", "Recent changes", "Random page", "Help", "Toolbox", "What links here", "Related changes", "Special pages", "Printable version", "Permanent link", and "Page information". The main content area has tabs for "Page", "Discussion", "Read", "View source", and "View history". Below the tabs is a search bar. The "Contents [hide]" section lists the following items:

- 1 About this Workgroup
- 2 Charter
- 3 Communication
  - 3.1 Mail list
  - 3.2 Workgroup Meetings
- 4 Telco Project Technical Workshops
  - 4.1 OCP Engineering Workshop - University of New Hampshire, August 10, 2016
  - 4.2 OCP Telco Meetup - Seoul, Korea, June 9, 2016
  - 4.3 OCP Engineering Workshop - San Jose, CA June 2, 2016
  - 4.4 OCP Engineering Workshop - Austin, TX May 23, 2016
  - 4.5 OCP U.S. Summit - San Jose, CA Mar 9-10, 2016
  - 4.6 OCP Engineering Workshop - San Antonio, TX Sep 16, 2015
  - 4.7 OCP U.S. Summit - San Jose, CA Mar 9-11, 2015
- 5 Specs and Designs
- 6 Supporting Documents that may be valuable to designers

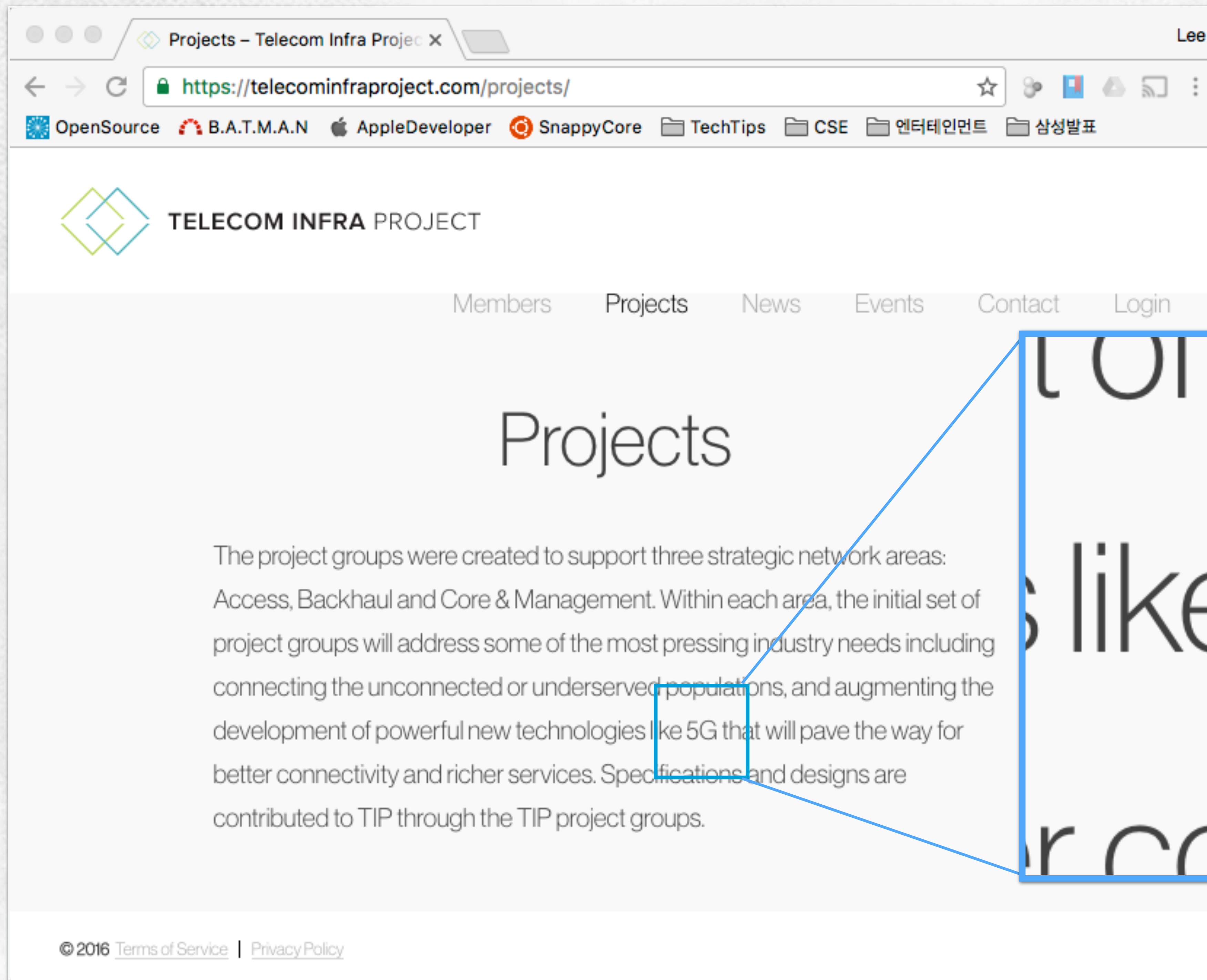
The "About this Workgroup" section states: "The TELCO/COMMS community was formed to assist with the adoption of open hardware and software within the Telco ecosystem." It lists three bullet points:

- Leverage the work of the network, server, rack, and storage projects. An imperative of this Telco WG is to align with these groups whenever possible.
- Recognize that there may be a unique attributes required and in such cases, the WG will define the usage and feature requirements and then work with the OCP community base and projects to fulfill these requirements.
- Provide a "single voice" to OCP Service Providers and member companies on unique needs of the Telecom's private cloud, and in doing such, the community acts as a 'buyers coop' for sourcing.

Project Co-Leads: Bryan Larish (Verizon), Kang Won Lee (SKT)  
Incubation Committee Representative: Fred Olivera (Verizon)

# OCP TIP

“TIP: Telecom Infra Project (under OCP)”



# OCP TIP

“TIP: Telecom Infra Project (under OCP)”



## Telecom Infra Project: Project Group Charter

2. Purpose. The OpenCellular group is working on developing architectures and designs for wireless access platforms and related technologies, targeting low cost, energy efficiency and easy maintainability. The goal is to innovate on the technology, engage with software projects developing solutions running on the OpenCellular platform, and support an ecosystem of OEMs, distributors and system integrator around OpenCellular based solutions.

# OCP TIP

## “TIP: Telecom Infra Project (under OCP)”

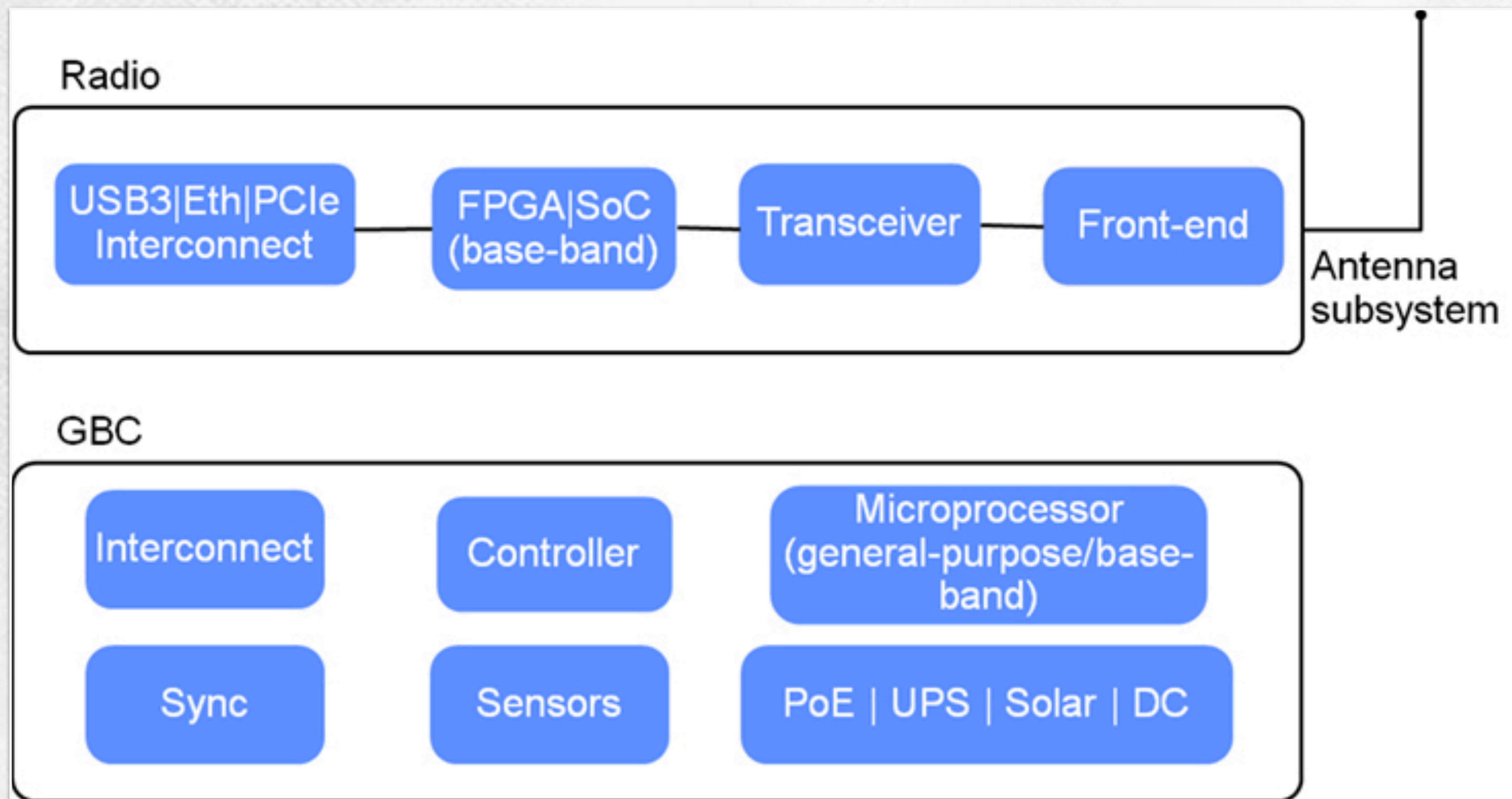
### 3. Project Group Scope.

Starting with the first version (known as Connect-1) of OpenCellular developed at Facebook, the project group will innovate in the areas of, but not necessarily limited to:

- Baseband and general-purpose processing module
- RF transceiver and timing sync module
- Intra and inter connect technologies
- Digital and analog front-end technologies including amplifiers and antenna sub-systems
- Board/system management and monitoring including out-of-band access techniques
- Integrated backhaul and power solutions including supporting and maximum utilization of locally available resources
- Industrial and mechanical designs
- PHY/Layer-1 implementation and upper layers integration support for various wireless access technologies
- Bootloader, firmware, RTOS, OS drivers and system security including remote management and upgrades
- Testing framework, infra and tools for production and on ground (deployments)
- Productizing, production optimization and innovative deployment models including support for local manufacturing and entrepreneurship for OpenCellular based solutions
- And every technology that has the potential to improve the efficiency, simplicity, manageability and handling of OpenCellular

# OCP TIP

“TIP: Access Projects”



# OCP TIP

## “TIP: Core and Management Projects”

This project group will deliver recipes for services/applications in the radio core network, leveraging open cloud architecture, libraries, software stacks and APIs. The group will provide a framework to enable disaggregated cloud scale computing for Radio Core Network (RCN) applications and services, such as IMS, P-Gateway, S-Gateway, EPC, etc. The scope also includes 5G & IOT infrastructure.

# OCP TIP

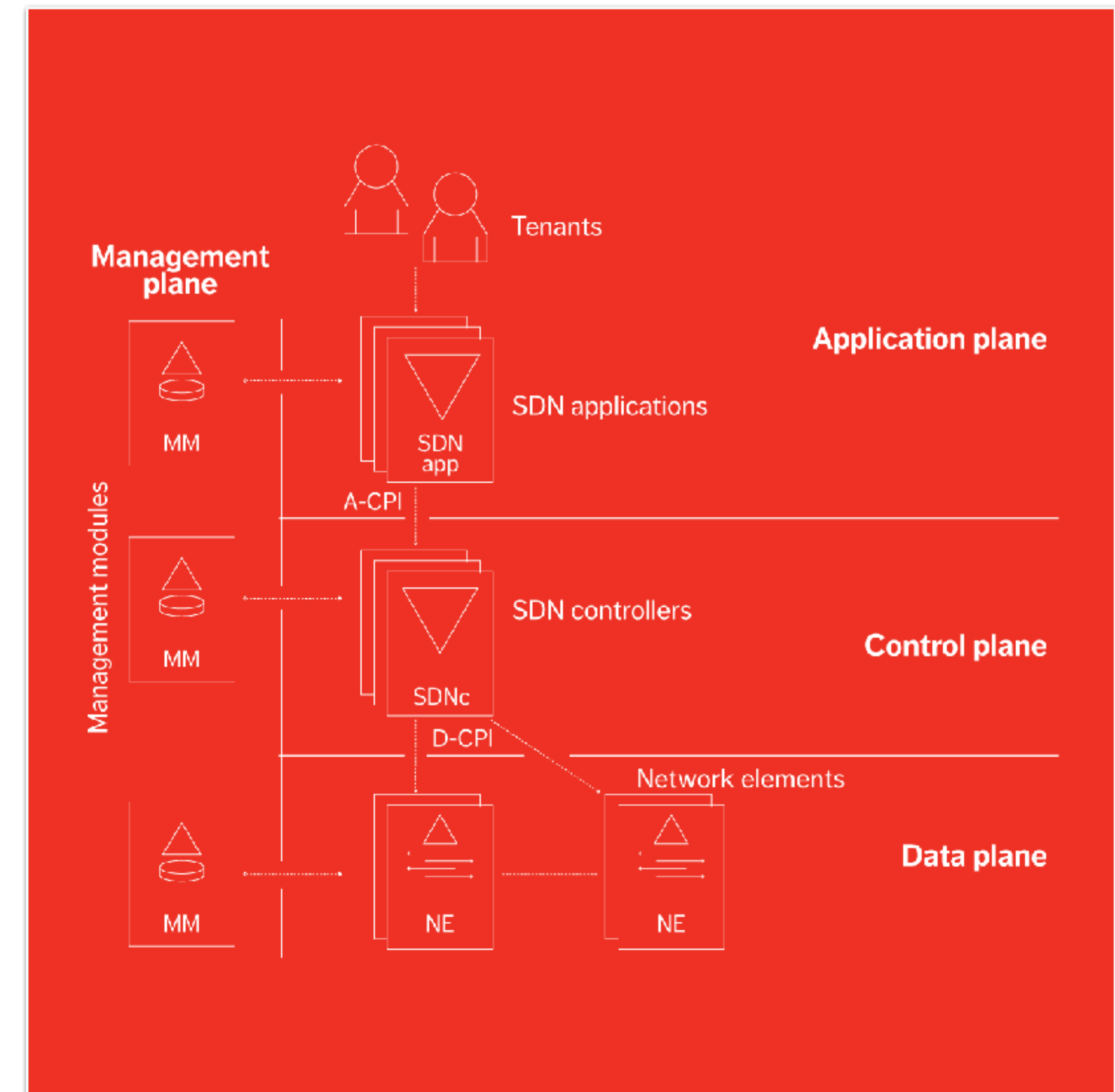
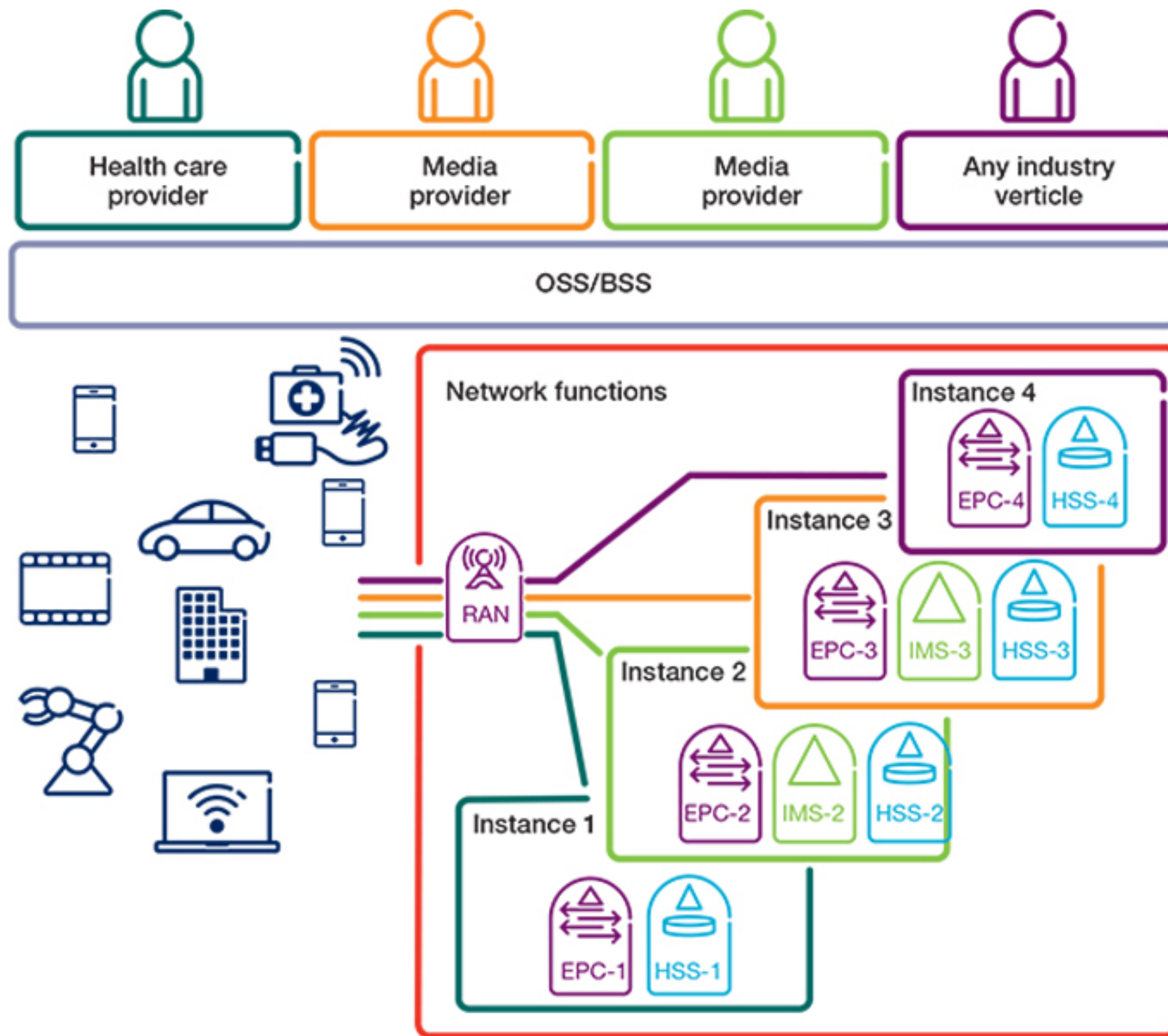
“이동통신에서의 콘텐츠 전송을 잘하고 싶은 ISP의 꿈”

Along with tackling connectivity trouble in the developing world, Facebook is also trying to make it easier for them to access rich media. Today it announced a test of **video downloads in India to enable offline viewing**. Facebook wants everyone, no matter where, on its social network.

출처: Telecom Crunch, 2016/07/06.

# OCP TIP

“일반 사용자에서 새로운 사용자(사업)를 받아들이는 그릇”



# 한국 개발자 커뮤니티

## ‘참여합시다~!’

# 한국 개발자 커뮤니티

“Open Source Networking, SDN and NFV”

SDN/NFV포럼

서비스PoC분과

ONOS/CORD WG

2016.9 시작

OCP WG

2017.4 시작

NFV WG

TBD

Open Wireless  
Access WG

TBD

# Fun5G 오픈소스

Future **U**nlicensed wireless/wired **N**etworking for **5** **G**oals :

Elementary school, junior high school, high school, university and small business.

## ✓ 필요 장비

- WLAN AP: Raspberry Pi 2/3
- WLAN 컨트롤러: 일반 PC

## ✓ 참여기관

- 경희대 이성원 교수팀
- 포항공대 송황준 교수팀
- 서울대 권태경 교수팀
- 경희대 홍충선 교수팀
- 성균관대 추현승 교수팀
- 성균관대 정민영 교수팀

## ✓ 주요기능

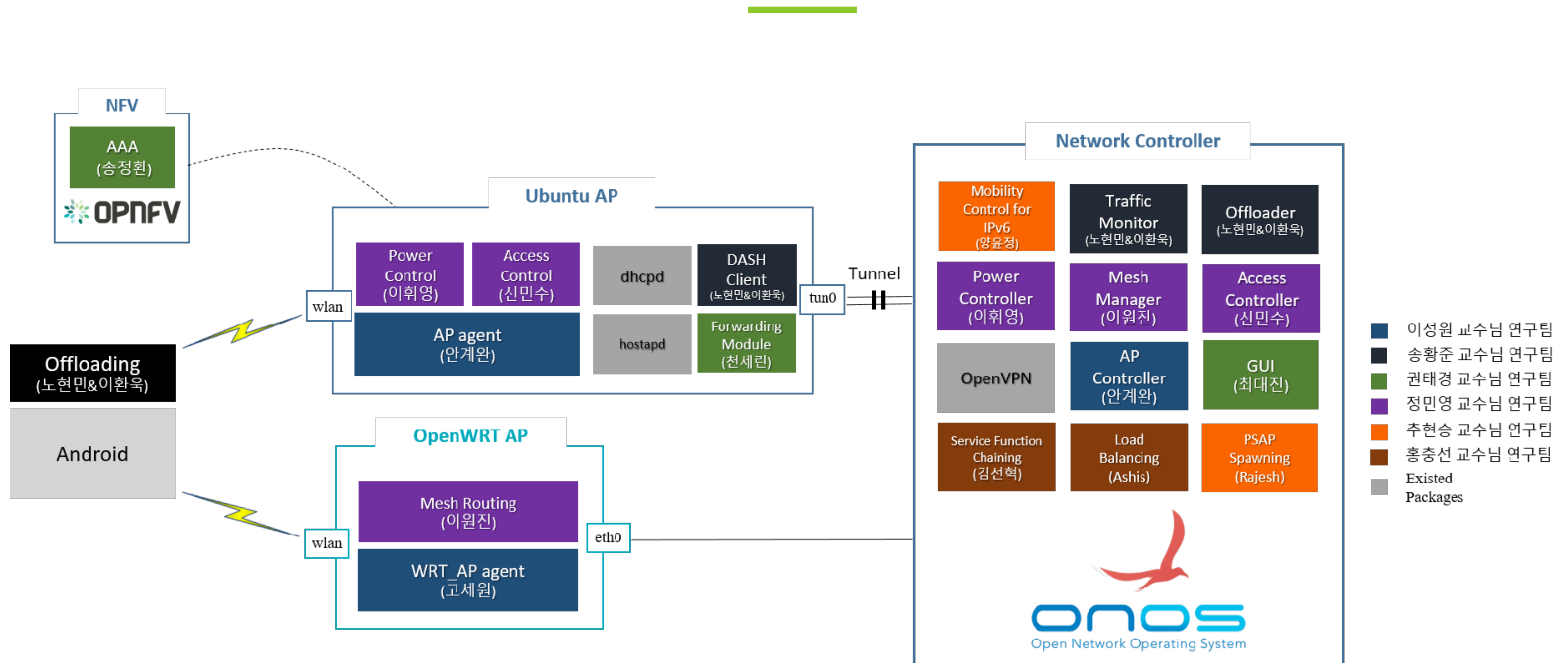
- WLAN AP 원격 관리 (HostAP, OpenWRT)
- WLAN AP 터널링 (VPN)
- 트래픽 경로 제어 (ONOS, OVS)
- 무선 자원 오프로딩 제어 (ONOS, Android)
- DASH 트래픽 제어 (ONOS, DASH agent)
- AAA (OPNFV/OpenStack, FreeRADIUS, OpenSSL)
- 가입자 관리 (OPNFV/OpenStack)
- IPv6기반 무선 핸드오버 (ONOS, OVS)
- 전송 전력제어 (ONOS, OVS)
- 액세스 컨트롤 (ONOS, HostAP)
- 팀 별로 기 개발된 아이템들을 지속적으로 추가중

## ✓ How to install?

<http://openwincon.khu.ac.kr/fun5g/installation/>

# Fun5G 오픈소스

## 프로그램 구조도



# GOTHAM 오픈소스

Visually Managed Open WiFi Mesh Networking

## ✓ 필요 장비

- WLAN AP: Raspberry Pi 2/3

## ✓ 참여기관

- 경희대 이성원 교수팀
- 성균관대 정민영 교수팀

## ✓ 주요기능

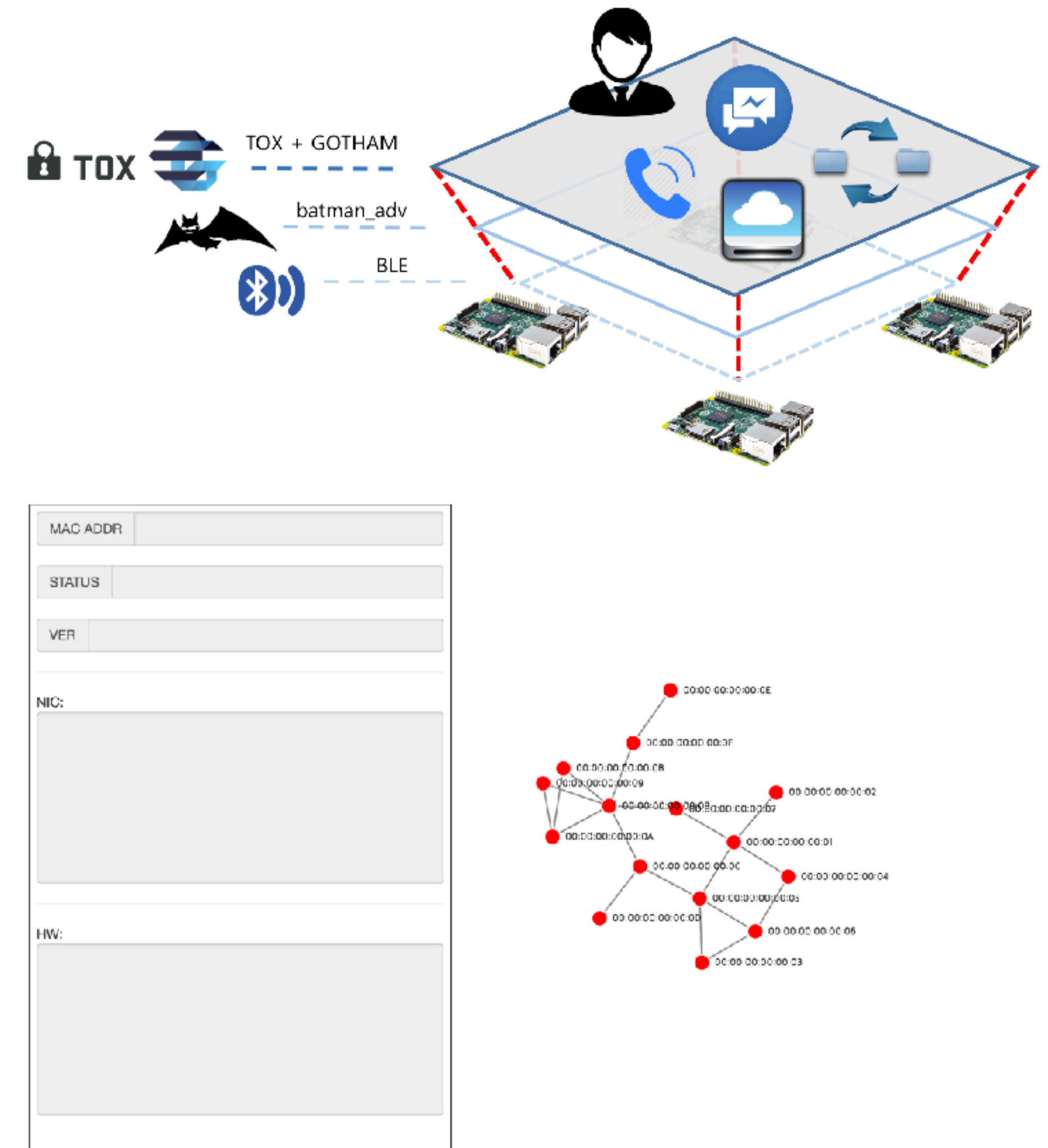
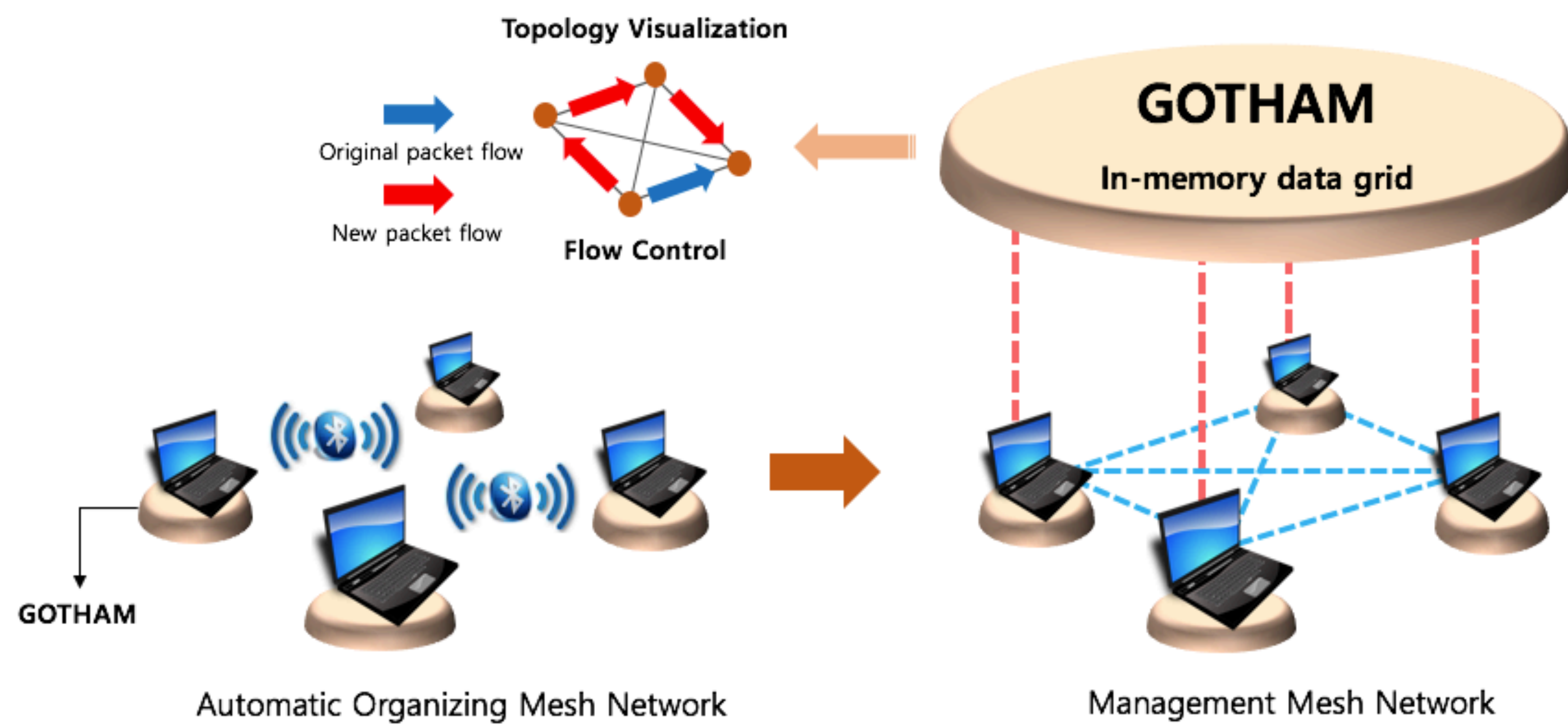
- 시각화된 WiFi Mesh 네트워크 관리
- 완전 분산 형태의 데이터 관리
- Bluetooth Beacon 기반 Self Organizing 기능
- TOX Server-less 인스턴트 메시징
- 생체 모방 기술 기반 Non-IP 통신(TBD)
- Fun5G 연동 통한 중앙 집중형 망 확장

## ✓ How to install?

<http://openwincon.khu.ac.kr/gotham/installation/>

# GOTHAM 오픈소스

Visually Managed Open WiFi Mesh Networking





## OCP TIP 중심의 오픈소스 5G/IoT 이동통신 구현 기술

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